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Bulletin 232 April, 1930

# *Wintering Dairy Heifers by Means of the Self-Feeder*

by H. O. HENDERSON and E. L. ANTHONY

A Typical Self-fed Heifer (No. 81)

A Typical Hand-fed Heifer (No. 84)

AGRICULTURAL EXPERIMENT STATION
COLLEGE OF AGRICULTURE, WEST VIRGINIA UNIVERSITY
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# *The Use of the Self-Feeder in Wintering Dairy Heifers**

by H. O. HENDERSON and E. L. ANTHONY†‡

THE use of a self-feeder in the feeding of livestock first received wide-spread approval among hog feeders in the Central West. The high cost of raising heifers to replace the dairy cows which for various reasons are removed from the dairy herd presents a real economic problem, and any practice which will reduce this cost or add to the success of calf raising, if adopted, would effect a real saving to the dairy cattle industry. It would seem, therefore, that the self-feeder scheme might offer definite advantages in the problem of raising replacement heifers.

## REVIEW OF LITERATURE

The use of the self-feeder in the feeding of calves, heifers, and even milking cows has been tried in a limited way at various agricultural experiment stations. The Nebraska Station *(6)* fed one group of calves under 6 months of age by means of the self-feeder, while another group was fed hay and grain twice a day in the usual manner. It was found that the self-fed heifers consumed large amounts of grain as compared to the hand-fed heifers but at the same time made much more rapid gains in weight. The total digestible nutrients required for one pound of gain in weight was less with the self-fed heifers than with the hand-fed heifers. There was also a material saving in the amount of labor required to care for the self-fed heifers as compared with the hand-fed heifers.

The Montana Station *(1)*, *(9)* in a similar experiment with calves under 6 months of age found that very large gains in live weight may be attained by the use of self-feeders, but that just as good gains can be made with hand-fed calves if good feeding is practised. It was concluded that self-feeders for growing dairy calves have no merits over hand-feeding.

At the Iowa Station *(3)*, *(5)* it was found that calves fed by means of the self-feeder consumed a ration of much narrower nutritive ratio than is generally recommended. It was also found that dairy calves can be fed economically until 6 months of age with a self-fed mixture of cracked corn, ground oats, wheat bran, and linseed oilmeal.

*Submitted for publication May, 1929.

†Warren Gifford, assistant professor of dairy husbandry, University of Missouri, also assisted with the experiment during 1923-1925.

‡Mr. Anthony resigned in September, 1928.

The South Dakota Station *(8)* found that the self-feeder was not an efficient method of raising calves, for the calves consumed too much of high-protein materials, thus making a very expensive ration. In this experiment growing calves were not able to select to the best advantage the proper feeds for themselves.

All of these experiments were conducted with calves up to 6 months of age. The Iowa Station *(4)*, however, raised one group of 3 calves from birth until two years of age on the self-feeder. These calves were given access to a hopper which contained shelled corn, cracked corn, whole oats, ground oats, wheat bran, and linseed oil-meal. They were allowed to run in a small pasture during the summer months for their roughage, but had access to the grain at all times. Very little difference was noted in the feed cost of raising heifers to two years of age by the self-feeder method, or by hand-feeding if a liberal grain allowance was given. The feed cost per pound of gain was lower with the self-fed heifers. It was found also that the heifers raised on the self-feeders showed the greatest increase in live weight, height, depth, and width.

The self-feeder has also been tried with milking cows *(2)*, *(7)*, but with poor results. The cows consumed much more than was required for their maintenance and milk production, while the milk yield was not appreciably increased. The cows tended to lay on additional weight, thus increasing the maintenance cost.

As far as can be determined, no experiments have been tried to ascertain the practicability of wintering heifers by means of the self-feeder and by turning them on pasture during the summer months without additional feed. The cost of caring for such heifers would evidently be considerably less. If a method could be evolved which would enable dairymen to reduce the customary labor of two years' feeding necessary before a heifer comes into milk, or which would reduce the winter feeding to one year, or which would bring heifers to a state of maturity whereby more nearly 100 percent mature production could be obtained with the first calf, important economic savings would result. To determine if such results could be obtained an experiment was started at the West Virginia Station on the use of the self-feeder, employing different groups of dairy calves and heifers. Results were obtained for 3 trials. The first two trials included only heifers during their second year, while in the third trial calves were put on the experiment at about 4 months of age, and the results of two years' feeding were included. The results obtained from these trials are presented in this bulletin.

## PLAN OF EXPERIMENT

The experiment was conducted for the 3 periods 1921-22, 1923-24, and 1923-25. Two groups of heifers were used during each trial. One group was fed during the winter months a ration as near to its requirements as was practicable and in some cases even slightly below requirement, as stated by the Morrison Feeding Standard, while the animals in the other groups were fed all the roughage they

TABLE 1.—*Breed, Age, and Size of Heifers Used in the First Trial, 1921-22, at the Beginning of the Trial*

| No. of Heifer | Breed | Age | | | Size | |
|---|---|---|---|---|---|---|
| | | Yrs. | Mos. | Days | Weight *(pounds)* | Height at Withers *(centimeters)* |
| GROUP I. (SELF-FED) | | | | | | |
| 39 | Holstein | 1 | 2 | 14 | 675 | 132.0 |
| 41 | Holstein | 1 | 1 | 7 | 525 | 123.2 |
| 44 | Jersey | | 11 | 7 | 450 | 111.8 |
| 45 | Holstein | | 9 | 25 | 535 | 125.7 |
| Average | | 1 | 0 | 3 | 546 | 123.2 |
| GROUP II. (HAND-FED) | | | | | | |
| 32 | Guernsey | 1 | 7 | 10 | 610 | 122.0 |
| 40 | Holstein | 1 | 2 | 0 | 655 | 132.2 |
| 42 | Holstein | 1 | 0 | 25 | 505 | 116.8 |
| 46 | Holstein | | 8 | 6 | 530 | 119.5 |
| Average | | 1 | 1 | 16 | 575 | 122.6 |

would consume and were given access to a hopper which was kept filled with cornmeal, wheat bran, and linseed oilmeal. As soon as pasture season arrived (usually about May 5 to 10) all of the heifers from both groups were turned on a large pasture (about 75 acres). The pasture was fairly good until late summer, when it would become quite short and dry. With the early fall rains the pasture would improve and would again give fair yield until late fall (usually about November 20 to 25), after which the heifers would be put into the stable.

In the stable the heifers were housed in large open sheds. They were not tied, but were allowed to go and come as they desired. Some trouble was experienced in keeping the larger heifers from fighting the smaller ones. This was especially true in the case of the hand-fed groups, but since the group as a whole was considered rather than the individual, this circumstance should affect the results but

TABLE 2.—*Breed, Age, and Size of Heifers Used in the Second Trial, 1923-24, at the Beginning of the Trial*

| No. of Heifer | Breed | Age | | | Size | |
|---|---|---|---|---|---|---|
| | | Yrs. | Mos | Days | Weight *(pounds)* | Height at Withers *(centimeters)* |
| GROUP III. (SELF-FED) | | | | | | |
| 71 | Holstein | 1 | 5 | 11 | 721.5 | 129.5 |
| 73 | Holstein | 1 | 3 | 7 | 605 | 124.5 |
| 81 | Holstein | 1 | 0 | 3 | 471 | 116.8 |
| 83 | Holstein | | 10 | 2 | 381.5 | 112.0 |
| 86 | Guernsey | | 8 | 18 | 300 | 102.0 |
| Average | | 1 | 0 | 18 | 495.8 | 116.9 |
| GROUP IV. (HAND-FED) | | | | | | |
| 70 | Holstein | 1 | 5 | 11 | 721.5 | 129.5 |
| 72 | Holstein | 1 | 3 | 29 | 596 | 120.2 |
| 77 | Holstein | 1 | 1 | 28 | 567.5 | 122 |
| 84 | Holstein | | 9 | 28 | 385 | 116.5 |
| 85 | Guernsey | | 9 | 16 | 295 | 104 |
| Average | | 1 | 1 | 9 | 513 | 118.4 |

little. The self-fed groups were fed concentrates in the self-feeder and were allowed free access to roughage. Records were kept of the feed consumed as well as of feed wasted. Salt and water were kept before the animals of each group at all times.

Each group was weighed and the height at the withers was measured every two weeks during the winter months and at monthly intervals during the summer months. A record was kept of the amount of feed consumed by each group.

Tables 1, 2, and 3 give breed, age, and size of the heifers at the beginning of the experiment.

TABLE 3.—*Breed, Age, and Size of Heifers Used in the Third Trial, 1923-25, at the Beginning of the Trial*

| No. of Heifer | Breed | Age | | Size | |
|---|---|---|---|---|---|
| | | Mos. | Days | Weight *(pounds)* | Height at Withers *(centimeters)* |
| GROUP V. (SELF-FED) | | | | | |
| 111 | Holstein | 4 | 16 | 320 | 109.0 |
| 113 | Jersey | 3 | 28 | 230 | 95.7 |
| 114 | Ayrshire | 3 | 20 | 255 | 98.3 |
| 116 | Holstein | 2 | 29 | 290 | 100.3 |
| Average | | 3 | 26 | 274 | 100.8 |
| GROUP VI. (HAND-FED) | | | | | |
| 109 | Holstein | 5 | 7 | 350 | 103.5 |
| 110* | Jersey | 4 | 24 | 240 | 95.7 |
| 112 | Holstein | 4 | 17 | 262 | 100.5 |
| 115 | Jersey | 3 | 12 | 210 | 90.5 |
| 141 | Ayrshire | 11 | 18 | 490 | 109 |
| Average (Omitting No. 141) | | 4 | 15 | 265 | 97.5 |

*No. 110 died of paint-poisoning in July, 1924, and No. 141 was put in her place for the second year's work beginning Nov. 15, 1924.

## METHOD OF FEEDING

*Feeding during First Trial.*—In Trial I, which started on November 24, 1921, each group was fed daily 6 pounds of alfalfa hay per head and 3 pounds of corn silage for each 100 pounds of live weight. In addtion Group I was allowed free access to a hopper filled with wheat bran, cornmeal, and linseed oilmeal. On December 13 the amount of silage fed to Group I was decreased to 1½ pounds per hundred-weight, which was as much as they would consume.

The heifers in Group II were fed an average of 5 pounds per head daily of a grain mixture consisting of 300 pounds of wheat bran, 200 pounds of cornmeal, and 150 pounds of linseed oilmeal.

The average daily amount of feed, digestible protein, total digestible nutrients, and net energy consumed by the heifers in Groups I and II and the amount required as calculated from the Morrison Feeding Standard is given in Table 4.

This table shows that the self-fed group daily consumed 1.794 pounds of digestible protein and 5.425 pounds of total digestible nutrients more than they would have required if on the basis of the recognized feeding standards. Each also consumed daily 1.499

pounds of protein and 5.863 pounds of digestible nutrients more than did the heifers in the hand-fed group. The hand-fed group was fed almost the exact amount of feed as required by the feeding standard.

*Feeding during Second Trial*—In Trial II, begun December 1, 1923, each group was started with 30 pounds of mixed hay and 30 pounds of corn silage per day. This amount was varied according to the appetites of the heifers. The animals in the self-fed group would not consume this amount, while those in the hand-fed group consumed a larger amount as they grew older.

As in Trial I, Group III, the self-fed group, was allowed free access to a hopper filled with cornmeal, linseed oilmeal, and wheat bran, while Group IV, the hand-fed group, was fed a ration consisting of 300 pounds of wheat bran, 200 pounds of cornmeal, and 150 pounds of linseed oilmeal. This mixture was fed in amounts so that the heifers were receiving nearly a balanced ration according to the feeding standards.

The average amount of feed, digestible protein, total digestible nutrients, and net energy consumed by each group per day as compared to the amount required is given in Table 5. This table shows

TABLE 4.—*Average Amount of Digestible Protein, Total Digestible Nutrients, and Net Energy Consumed Daily by Heifers in Groups I and II of Trial I, as Compared to Their Requirements*

| Average Amount of Feed Consumed Per Heifer | Analyses | | |
|---|---|---|---|
| | Digestible Protein *(pounds)* | Tot. Dig. Nutrients *(pounds)* | Therms Net Energy |
| GROUP I. (SELF-FED) | | | |
| 9.1 pounds corn silage contains | 0.100 | 1.611 | 1.446 |
| 6.0 pounds alfalfa hay contains | 0.636 | 3.096 | 2.054 |
| 15.1 pounds roughage contains | 0.736 | 4.707 | 3.500 |
| 5.42 pounds cornmeal contains | 0.385 | 4.420 | 4.769 |
| 4.90 pounds linseed oilmeal contains | 1.490 | 3.817 | 4.361 |
| 3.48 pounds wheat bran contains | 0.435 | 2.119 | 1.844 |
| 13.80 pounds grain contains | 2.310 | 10.356 | 10.974 |
| Total ration contains | 3.046 | 15.163 | 14.474 |
| Requirements of 695.6-pound heifer | 1.252 | 9.738 | |
| Daily amount fed in excess of requirements | 1.794 | 5.425 | |
| GROUP II. (HAND-FED) | | | |
| 15 pounds corn silage contains | 0.165 | 2.655 | 2.385 |
| 6 pounds alfalfa hay contains | 0.636 | 3.096 | 2.054 |
| 21 pounds roughage contains | 0.801 | 5.751 | 4.439 |
| 1.55 pounds cornmeal contains | 0.109 | 1.258 | 1.355 |
| 1.15 pounds linseed oilmeal contains | 0.352 | 0.896 | 1.023 |
| 2.30 pounds wheat bran contains | 0.286 | 1.395 | 1.214 |
| 5 pounds grain contains | 0.746 | 3.549 | 3.592 |
| Total ration contains | 1.547 | 9.300 | 8.031 |
| Requirements of 677.5-pound heifer | 1.230 | 9.485 | |
| Daily amount fed in excess of requirements | 0.317 | 0.185 | |

TABLE 5.—*Average Amount of Feed, Digestible Protein, Total Digestible Nutrients, and Net Energy Consumed Daily by Heifers in Groups III and IV of Trial II, as Compared to Their Requirements*

| Average Amount of Feed Consumed Per Heifer | Analyses | | |
|---|---|---|---|
| | Digestible Protein *(pounds)* | Tot. Dig. Nutrients *(pounds)* | Therms Net Energy |
| GROUP III. (SELF-FED) | | | |
| 6.70 pounds corn silage contains | 0.744 | 1.186 | 1.065 |
| 3.86 pounds mixed hay contains | 0.154 | 1.783 | 1.579 |
| 10.56 pounds roughage contains | 0.228 | 2.969 | 2.644 |
| 0.31 pounds cornmeal contains | 0.022 | 0.253 | 0.273 |
| 6.76 pounds linseed oilmeal contains | 2.075 | 5.266 | 6.016 |
| 7.99 pounds wheat bran contains | 0.999 | 4.866 | 4.235 |
| 15.06 pounds grain contains | 3.096 | 10.385 | 10.524 |
| Total ration contains | 3.324 | 13.354 | 13.168 |
| Requirements of 659-pound heifer | 1.186 | 9.226 | |
| Daily nutrients consumed in excess of requirements | 2.238 | 4.128 | |
| GROUP IV. (HAND-FED) | | | |
| 12.26 pounds corn silage contains | 0.135 | 2.170 | 1.949 |
| 7.46 pounds mixed hay contains | 0.298 | 3.447 | 3.051 |
| 19.72 pounds roughage contains | 0.433 | 5.617 | 5.000 |
| 1.15 pounds cornmeal contains | 0.082 | 0.939 | 1.012 |
| 0.86 pounds linseed oilmeal contains | 0.263 | 0.670 | 0.765 |
| 1.73 pounds wheat bran contains | 0.216 | 1.054 | 0.917 |
| 3.84 pounds grain contains | 0.561 | 2.663 | 2.694 |
| Total ration contains | 0.994 | 8.280 | 7.694 |
| Requirements of 609.6-pound heifer | 1.097 | 8.534 | |
| Daily amount consumed less than requirements | −0.103 | −0.254 | |

that each heifer in the self-fed group daily consumed 2.238 pounds of digestible protein and 4.128 pounds of total digestible nutrients more than they required. They consumed on the average 11.22 pounds more grain but 9.16 pounds less roughage per day than did the heifers in the hand-fed group. Each animal also consumed 2.330 pounds of digestible protein and 4.382 pounds of total digestible nutrients more per day than did the heifers in Group IV, which was fed by hand. The heifers in Group IV were fed slightly less of both digestible protein and total digestible nutrients than their requirements.

*Feeding during Third Trial.*—Trial III was started December 21, 1923, although one calf in each group was not put in the experiment until January 16, 1924. This experiment continued throughout two years. The calves during the first feeding period were much younger than those in Trials I and II. The calves in both groups had been fed skimmilk up until the time they were put on the experiment and for some time afterward. However, just as soon as they became accustomed to eating grain and roughage, the milk was discontinued.

Both groups were fed all the corn silage and alfalfa hay they

would eat. For some time soybean hay was fed instead of alfalfa hay. Group V was allowed free access to a hopper filled with cornmeal, wheat bran, ground oats, and linseed oilmeal, while Group VI was fed, according to its requirements, a ration consisting of 300 pounds of cornmeal and 100 pounds each of wheat bran, ground oats, and linseed oilmeal.

Table 6 gives the average amount of feed, digestible protein, digestible nutrients, and net energy consumed by the heifers of each group per day as compared to the amount required. This is for the first feeding period.

Table 6 shows that during the first year the heifers in the self-fed group (Group V) each consumed on the average 2.208 pounds of digestible protein and 4.114 pounds of total nutrients more than is called for by the feeding standard. Each also consumed daily 8.27 pounds of grain, and 2.08 pounds of digestible protein, 4.478 pounds of total nutrients, and 5.142 therms net energy more than the heifers

TABLE 6.—*Average Amount of Feed, Digestible Protein, Digestible Nutrients, and Net Energy Consumed Daily by Heifers in Groups V and VI of Trial III during the First Feeding Period, as Compared to Their Requirements*

| Average Amount of Feed Consumed Per Heifer | Analyses | | |
|---|---|---|---|
| | Digestible Protein *(pounds)* | Tot. Dig. Nutrients *(pounds)* | Therms Net Energy |
| GROUP V. SELF-FED GROUP (FIRST WINTER-FEEDING PERIOD) | | | |
| 5.38 pounds corn silage contains | 0.059 | 0.952 | 0.855 |
| 0.80 pounds soybean hay contains | 0.093 | 0.429 | 0.352 |
| 3.06 pounds alfalfa hay contains | 0.324 | 1.579 | 1.047 |
| 9.24 pounds roughage contains | 0.476 | 2.960 | 2.254 |
| 0.95 pounds cornmeal contains | 0.067 | 0.776 | 0.836 |
| 5.15 pounds linseed oilmeal contains | 1.576 | 4.012 | 4.584 |
| 4.12 pounds wheat bran contains | 0.515 | 2.509 | 2.184 |
| 0.51 pounds ground oats contains | 0.495 | 0.495 | 0.347 |
| 10.73 pounds grain contains | 2.653 | 7.792 | 7.951 |
| Total ration contains | 3.129 | 10.752 | 10.205 |
| Requirements of 428.3-pound heifer | 0.921 | 6.638 | |
| Daily amount consumed in excess of requirements | 2.208 | 4.114 | |
| GROUP VI. HAND-FED GROUP (FIRST WINTER-FEEDING PERIOD) | | | |
| 5.90 pounds corn silage contains | 0.065 | 1.044 | 0.938 |
| 1.14 pounds soybean hay contains | 0.133 | 0.611 | 0.502 |
| 5.13 pounds alfalfa hay contains | 0.548 | 2.647 | 1.754 |
| 12.17 pounds roughage contains | 0.746 | 4.302 | 3.194 |
| 1.23 pounds cornmeal contains | 0.077 | 1.005 | 1.008 |
| 0.41 pounds linseed oilmeal contains | 0.125 | 0.319 | 0.365 |
| 0.41 pounds wheat bran contains | 0.051 | 0.250 | 0.217 |
| 0.41 pounds ground oats contains | 0.040 | 0.398 | 0.279 |
| 2.46 pounds grain contains | 0.303 | 1.972 | 1.869 |
| Total ration contains | 1.049 | 6.274 | 5.063 |
| Requirements of 345-pound heifer | 0.845 | 5.692 | |
| Daily amount consumed in excess of requirement | 0.204 | 0.582 | |

in the hand-fed group (Group VI). The calves in Group VI were fed just a little above their requirements.

Both of these groups were turned on pasture during the summer, but when brought into the barn in the fall of 1924 they again were put on the experiment (Nov. 20, 1924). Group V again was fed all of the roughage the animals would eat and given free access to a hopper filled with cornmeal, linseed oilmeal, and wheat bran. Group VI was fed a good supply of roughage and a grain ration consisting of 300 pounds of wheat bran, 200 pounds of cornmeal, and 150 pounds of linseed oilmeal.

Table 7 gives the average amount of feed, digestible protein, digestible nutrients, and net energy consumed daily by each heifer in each group as compared to the amount required during the second winter. This table shows that during the second feeding period of Trial III the heifers in Group V consumed 2.246 pounds of digestible protein and 7.03 pounds of digestible nutrients more per day than their requirements. The heifers in Group VI on the other hand were fed just a little above their requirements for digestible protein, but received 1.783 pounds of digestible nutrients less on the average than

TABLE 7.—*Average Amount of Feed, Digestible Protein, Digestible Nutrients, and Net Energy Consumed Daily by Heifers in Groups V and VI in Trial III during the Second Feeding Period, as Compared with Their Requirements*

| Average Amount of Feed Consumed Per Heifer | Analyses | | |
|---|---|---|---|
| | Digestible Protein *(pounds)* | Tot. Dig. Nutrients *(pounds)* | Therms Net Energy |
| GROUP V. SELF-FED GROUP (SECOND WINTER-FEEDING PERIOD) | | | |
| 7.50 pounds corn silage contains | 0.083 | 1.328 | 1.193 |
| 5.86 pounds alfalfa hay contains | 0.621 | 3.024 | 2.004 |
| 13.36 pounds roughage contains | 0.704 | 4.352 | 3.197 |
| 7.69 pounds cornmeal contains | 0.546 | 6.283 | 6.767 |
| 6.51 pounds linseed oilmeal contains | 1.992 | 5.071 | 5.794 |
| 2.66 pounds wheat bran contains | 0.333 | 1.620 | 1.410 |
| 16.86 pounds grain contains | 2.871 | 12.974 | 13.971 |
| Total ration contains | 3.575 | 17.326 | 17.168 |
| Requirement of 830.3-pound heifer | 1.329 | 10.296 | |
| Amount fed in excess of requirement | 2.246 | 7.030 | |
| GROUP VI. HAND-FED GROUP (SECOND WINTER-FEEDING PERIOD) | | | |
| 7.50 pounds corn silage contains | 0.083 | 1.328 | 1.193 |
| 7.07 pounds alfalfa hay contains | 0.749 | 3.648 | 2.418 |
| 14.57 pounds roughage contains | 0.832 | 4.976 | 3.611 |
| 0.797 pounds cornmeal contains | 0.057 | 0.651 | 0.701 |
| 0.597 pounds linseed oilmeal contains | 0.183 | 0.465 | 0.531 |
| 1.195 pounds wheat bran contains | 0.149 | 0.728 | 0.633 |
| 2.589 pounds grain contains | 0.389 | 1.844 | 1.865 |
| Total ration contains | 1.221 | 6.821 | 5.471 |
| Requirement of 581.25-pound heifer | 1.104 | 8.603 | |
| Amount fed in excess of requirement | 0.117 | —1.783 | |

their requirements. The heifers in Group V each consumed 6½ times as much grain per day as did those in Group VI, but not as much roughage, although they were given all they would eat. It can also be seen that the heifers in Group VI obtained 80.3 percent of their digestible proteins and 74.9 percent of their digestible nutrients from their grain ration, while those in Group VI obtained only 31.8 percent of their digestible protein and 27.0 percent of their digestible nutrients from their grain ration.

TABLE 8.—*Summary of First Feeding Trial (1921-22)*

| Item | Group I (Self-fed) | Group II (Hand-fed) |
|---|---|---|
| WINTER PERIOD (158 DAYS) | | |
| Number of heifers | 4 | 4 |
| Pounds gain in weight | 298.8 | 205.0 |
| Pounds gain per day | 1.89 | 1.30 |
| Pounds of grain per pound gain | 7.29 | 3.83 |
| Pounds of digestible protein per pound gain | 1.61 | 1.19 |
| Pounds of digestible nutrients per pound gain | 4.65 | 5.28 |
| Therms net energy per pound gain | 7.56 | 6.19 |
| Height at withers gained *(cm.)* | 10. | 10. |
| Pounds of grain per cm. gain in height | 872.9 | 316.1 |
| SUMMER PERIOD (203 DAYS) | | |
| Pounds gain in weight | 60.2 | 177.5 |
| Pounds gain per day | 0.30 | 0.87 |
| Height at withers gained *(cm.)* | 4.5 | 6.5 |
| TOTAL PERIOD (361 DAYS) | | |
| Pounds gain in weight | 358.8 | 382.5 |
| Pounds gain per day | 0.99 | 1.06 |
| Pounds of grain required per pound gain | 6.07 | 2.06 |
| Pounds of digestible protein per pound gain | 1.34 | 0.64 |
| Pounds of digestible nutrients per pound gain | 6.68 | 3.84 |
| Therms net energy per pound gain | 6.37 | 3.32 |
| Height at withers gained *(cm.)* | 14.5 | 16.5 |

## RESULTS OF FEEDING TRIALS

*First Feeding Trial.*—In Trial I, which started on November 25, 1921, the heifers were fed for a winter period of 158 days and then turned on pasture for 203 days. The results of these periods and the combined periods are given in Table 8 and in Figures 1 and 2.

It will be seen that during the 158-day winter period the 4 heifers in Group I, the self-fed group, gained an average of 298.8 pounds each in weight, while those in Group II, the hand-fed group, gained only 205 pounds in weight. The heifers in Group I made an average daily gain for this period of 1.89 pounds as compared to 1.30 pounds for those in Group II. The heifers in the self-fed group were in much better flesh at the end of this period than were the heifers in the hand-fed group. However, no difference was found in regard to skeleton growth as denoted by the height at withers.

It required 7.29 pounds of grain for each pound of gain with self-feeders as against 3.83 pounds with hand-fed heifers. The self-fed heifers consumed almost one-third more digestible protein per pound of gain than did the hand-fed group, but only slightly more digestible nutrients, or net energy, were required per pound of gain. This would indicate that heifers will gain in weight according to the

FIGURE 1.—Average Gains in Weight (pounds) of Group I (self-fed) and Group II (hand-fed) by Months (1921-22)

amount of digestible nutrients they receive, but this is not true in regard to skeleton growth.

During the following summer, when the heifers of both groups were turned together in a common pasture, the heifers in the self-fed group each gained an average of only 60.2 pounds in weight and 4.5 cm. in height, while the heifers in the hand-fed group each gained an average of 177.5 pounds in weight and 6.5 cm. in height. The self-fed group had found life easy during the winter months, and grazing offered little inducement to exertion, while the hand-fed heifers worked all the harder.

For the total period of 361 days the animals in the hand-fed group gained an average of 382.5 pounds in weight, while the animals

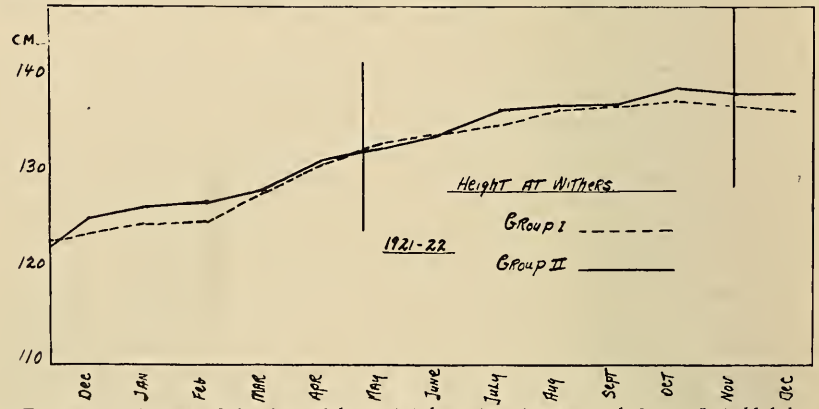


FIGURE 2.—Average Gains in Height at Withers (centimeters) of Group I (self-fed) and Group II (hand-fed) by Months (1921-22)

in the self-fed group gained an average of only 358.8 pounds. It required almost 3 times as much grain for one pound of gain in the self-fed group as in the hand-fed group. It also required about twice as much digestible protein, digestible nutrients, or net energy for one pound of gain, if no consideration is given to the food value of the pasture.

*Second Feeding Trial.*—In Trial II, which started on December 1, 1923, the heifers were fed for a winter period of 156 days and then turned on pasture for 194 days. The gains made by each group during these periods are given in Table 9 and in Figures 3 and 4.

TABLE 9.—*Summary of Second Feeding Trial (1922-23)*

| Item | Group III (Self-fed) | Group IV (Hand-fed) |
|---|---|---|
| WINTER PERIOD (156 DAYS) | | |
| Number of heifers | 5 | 5 |
| Pounds gain in weight | 326.3 | 193.2 |
| Average pounds gain per day | 2.09 | 1.24 |
| Pounds of grain per pound gain | 7.2 | 3.1 |
| Pounds of digestible protein per pound gain | 1.59 | 0.80 |
| Pounds of digestible nutrients per pound gain | 6.38 | 6.69 |
| Therms net energy per pound gain | 6.30 | 6.21 |
| Height at withers gained *(cm.)* | 14.1 | 9.0 |
| Pounds of grain per cm. gain in height | 836.1 | 324.4 |
| SUMMER PERIOD (194 DAYS) | | |
| Average pounds gain in weight | 165.9 | 218.3 |
| Average pounds gain per day | 0.83 | 1.13 |
| Average height at withers gained *(cm.)* | 4.3 | 8.4 |
| TOTAL PERIOD (350 DAYS) | | |
| Average pounds gain in weight | 492.2 | 411.5 |
| Average pounds gain per day | 1.41 | 1.18 |
| Pounds of grain required per pound gain | 4.77 | 1.45 |
| Pounds of digestible protein required per pound gain | 1.05 | 0.38 |
| Pounds of digestible nutrients required per pound gain | 4.23 | 3.14 |
| Therms net energy required per pound gain | 4.17 | 2.92 |
| Height at withers gained *(cm.)* | 18.4 | 17.4 |

It will be seen that the five heifers in Group III, the self-fed group, during the winter months made an average gain of 326.3 pounds in weight, which is at the rate of 2.09 pounds per day, while those in Group IV, the hand-fed group, made an average gain of only 193.2 pounds, which is at the rate of 1.24 pounds gain per day. The heifers in Group III were in very much better condition at the end of this time than were those in Group IV.

During this period the heifers in Group III made a gain of 14.1 cm. in height at withers, while those in Group IV made a gain of only 9.0 cm.

It required 7.2 pounds of grain for each pound of gain made in Group III and only 3.1 pounds of grain for each pound of gain in Group IV. Group IV, however, made use of considerably more roughage than did Group III. The self-fed heifers consumed almost twice as much digestible protein to make a pound of gain as did the hand-fed heifers. However, the amount of digestible nutrients or net energy required for a pound of gain was not much different in the two methods of feeding.

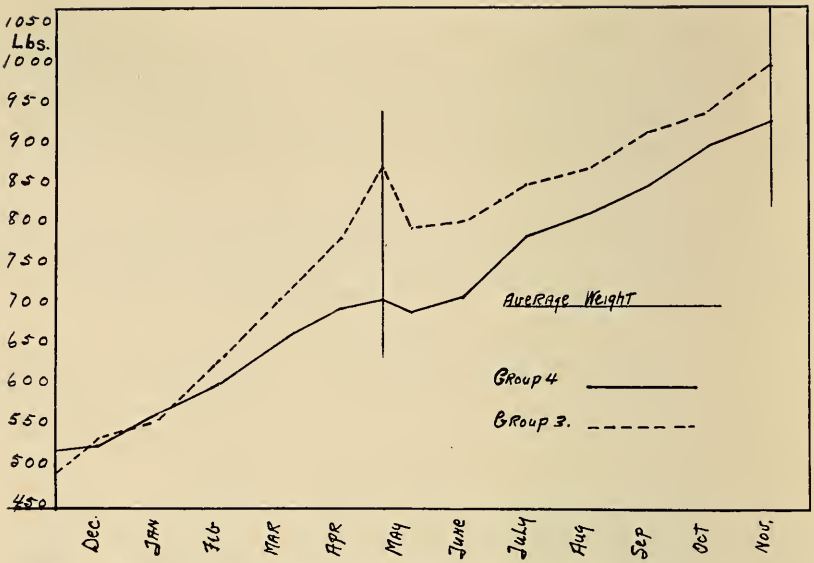


FIGURE 3.—Average Gains in Weight (pounds) of Group III (self-fed) and Group IV (hand-fed) by Months (1923-24)

During the following summer, when the heifers were turned into a common pasture (see Figs. 5 and 6), those in Group III, the self-fed group, gained an average of 165.9 pounds each in weight, while those in Group IV gained an average of 218.3 pounds in weight. During this period those in Group III gained at the rate of 0.83 pounds per day, while those in Group IV gained at the rate of 1.13 pounds per day. The heifers in Group IV also made much larger gains during

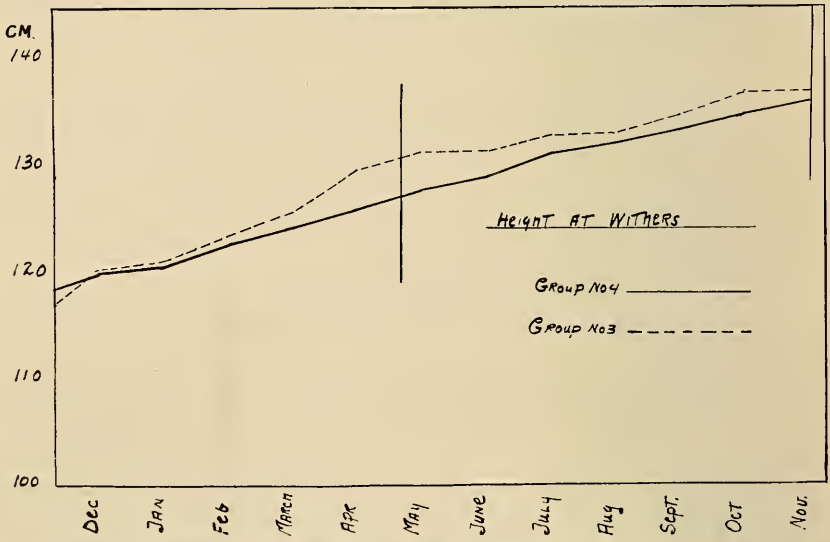


FIGURE 4.—Average Gains in Height at Withers (centimeters) of Group III (self-fed) and Group IV (hand-fed) by Months (1923-24)

FIGURE 5.—Group III (self-fed) as the animals appeared at time of turning on pasture in the spring

this period in skeleton growth, as denoted by the growth in height at withers. They gained an average of 8.4 cm. during this period as compared to 4.3 cm. for the self-fed group, Group III.

For the total period of 350 days the heifers in Group III made an average gain of 492.5 pounds each, while those in Group IV made a gain of 411.5 pounds. The heifers in Group III gained at the rate of 1.41 pounds per day, while those in Group IV gained at the rate of 1.18 pounds per day. For this entire period Group III consumed 4.77 pounds of grain for each pound of gain, while Group IV consumed 1.45 pounds of grain for each pound of gain. The heifers in Group III consumed almost 3 times as much protein as those in Group IV for each pound of gain and also considerably more digestible nutrients and net energy. No account, however, was taken of the amount of the various nutrients which were obtained from pasture.

*Third Feeding Trial.*—In Trial III, which started on December 21, 1923, the calves were fed for a winter period of 117 days and then turned out in a pasture together for a period of 198 days, after which they were returned to the stable for the second winter period. This period was 169 days in length. They were then turned out on pasture for a period of 198 days. The gains during the periods are shown in Table 10 and in Figures 7 and 8.

Table 10 shows that during the first winter period the calves in Group V made an average gain of 270.25 pounds each in weight, which was at the rate of 2.31 pounds per day. The calves in Group VI during the same period gained only 139 pounds in weight, which was at the rate of 1.19 pounds per day. During this period the calves in Group V gained 18.45 cm. in height, while those in Group VI gained only 12.25 cm.

FIGURE 6.—Group IV (hand-fed) as the animals appeared at time of turning on pasture in the spring

It required 4.64 pounds of grain to produce one pound in weight in Group V, the self-fed group, and only 2.07 pounds in Group VI, the hand-fed group. It required, however, very little more digestible nutrients or net energy for one pound gain in Group V than it did in Group VI.

During the following summer the calves in Group VI gained slightly more both in weight and in height than did those in Group V.

TABLE 10.—*Summary of Third Feeding Trial (1923-25)*

| Item | Group V (Self-fed) | Group VI (Hand-fed) |
|---|---|---|
| FIRST WINTER PERIOD (117 DAYS) | | |
| Number of heifers | 4 | 4 |
| Average pounds of gain in weight | 270.25 | 139.0 |
| Average pounds of gain per day | 2.31 | 1.19 |
| Pounds of grain per pound gain | 4.64 | 2 07 |
| Pounds of digestible protein per pound gain | 1.36 | 0 88 |
| Pounds of digestible nutrients per pound gain | 4.65 | 5.28 |
| Therms net energy | 4.42 | 4.26 |
| Height at withers gained *(cm.)* | 18.45 | 12.25 |
| Pounds of grain per cm. gain | 272.03 | 93.71 |
| FIRST SUMMER PERIOD (198 DAYS) | | |
| Average pounds gain in weight | 100 0 | 120.5 |
| Average pounds gain per day | 0 51 | 0.61 |
| Average height at withers gained *(cm.)* | 5.75 | 5.95 |
| TOTAL PERIOD FIRST YEAR (315 DAYS) | | |
| Average pounds gain in weight | 370.25 | 259.5 |
| Average pounds gain per day | 1.18 | 0.82 |
| Pounds of grain required per pound gain | 3.39 | 1.10 |
| Pounds of digestible protein required per pound gain | 0.99 | 0.47 |
| Pounds of digestible nutrients required per pound gain | 3.40 | 2.83 |
| Therms net energy required per pound gain | 2.76 | 2.28 |
| Height at withers gained *(cm.)* | 24.2 | 18.2 |
| SECOND WINTER PERIOD (169 DAYS) | | |
| Average pounds gain in weight | 370.6 | 72.5 |
| Average pounds gain per day | 2.19 | 0.43 |
| Pounds of grain per pound gain | 7.69 | 6.03 |
| Pounds of digestible protein per pound gain | 1.63 | 2.57 |
| Pounds of digestible nutrients per pound gain | 7.90 | 15.89 |
| Therms net energy per pound gain | 7.82 | 12.77 |
| Height at withers gained *(cm.)* | 13.2 | 5.4 |
| Pounds of grain per cm. gain | 863.6 | 324.0 |
| SECOND SUMMER PERIOD (198 DAYS) | | |
| Average pounds gain in weight | 14.9 | 143.7 |
| Average pounds gain per day | 0.075 | .726 |
| Height at withers gained *(cm.)* | 0.20 | 4.5 |
| TOTAL PERIOD SECOND YEAR (367 DAYS) | | |
| Average pounds gain in weight | 385.5 | 216.2 |
| Average pounds gain per day | 1 05 | 0.59 |
| Pounds of grain per pound gain | 7.39 | 2.02 |
| Pounds of digestible protein per pound gain | 1.57 | 0.95 |
| Pounds of digestible nutrients per pound gain | 7.60 | 6.72 |
| Therms net energy per pound gain | 7.52 | 4.28 |
| Height at withers gained *(cm.)* | 13.4 | 9.9 |
| TOTAL FOR BOTH YEARS (682 DAYS) | | |
| Average pounds gain in weight | 755.75 | 475.70 |
| Average pounds gain per day | 1.11 | 0.70 |
| Pounds of grain per pound gain | 5.43 | 1.52 |
| Pounds of digestible protein per pound gain | 1.21 | 0.69 |
| Pounds of digestible nutrients per pound gain | 5.54 | 3.96 |
| Therms net energy per pound gain | 5.41 | 3.19 |
| Height at withers gained *(cm.)* | 37.6 | 28.1 |

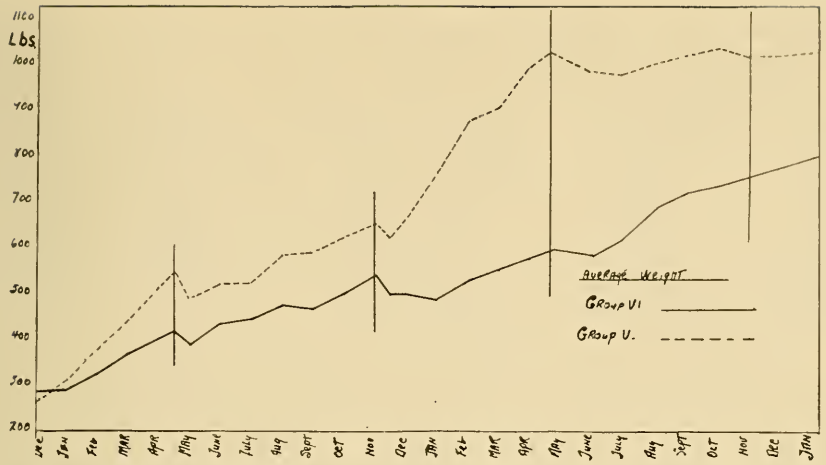


FIGURE 7.—Average Gains in Weight (pounds) of Group V (self-fed) and Group VI (hand-fed) by Months (1923-26)

However, they did not make as large gains as did the heifers in the other two trials. This was probably due to the fact that they were younger than the heifers in the previous groups and were not accustomed to consuming large quantities of pasture grass.

When the heifers were brought into the stable for the second feeding period those in Group V were noticeably larger than those in Group VI. During this second winter feeding period of 169 days the heifers in Group VI were fed a ration considerably below requirements as to digestible nutrients. As a result they made only small gains—an average of 72.5 pounds in weight and 5.4 cm. in height at withers. During the same period the heifers in Group V made a gain of 370.6 pounds each in weight and 13.2 cm. in height. They

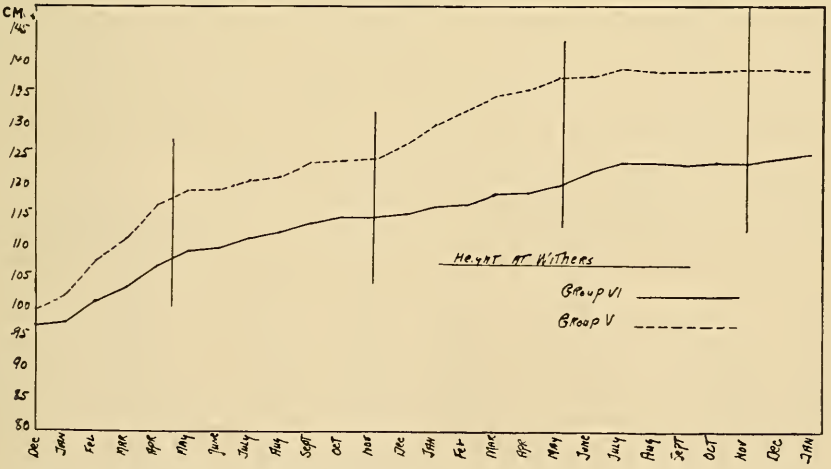


FIGURE 8.—Average Gains in Height at Withers (centimeters) of Group V (self-fed) and Group VI (hand-fed) by Months (1923-26)

made an average daily gain of 2.19 pounds, while the heifers in Group VI gained only 0.43 pounds per day.

To make these gains, however, it required in the case of Group V, the self-fed group, 7.69 pounds of grain for each pound of gain and only 6.03 pounds in the case of the heifers in Group VI. It required 2.57 pounds of digestible protein to produce a pound of gain in the case of the heifers in Group VI and only 1.63 pounds in the case of those in Group V. It also required 15.89 pounds of digestible nutrients, or 12.77 therms net energy, to make one pound of gain by the animals in Group VI as compared with 7.90 pounds of digestible nutrients or 7.82 therms net energy per pound of gain as made by the animals in Group V.

During the second summer the animals in Group V made practically no gain either in weight or in height at withers. The heifers had reached their full size during the period of heavy feeding. The heifers in Group VI, however, gained an average of 143.7 pounds each in weight and 4.5 cm. in height during the period. During this second year the heifers in Group V made a total gain of 385.5 pounds each in weight and 13.4 cm. in height at withers, while the heifers in Group VI were making a gain of only 216.2 pounds each in weight and 9.9 cm. in height at withers.

During the two years the heifers in Group V gained an average of 755.75 pounds each in weight and 37.6 cm. in height, while those in Group VI gained only 475.7 pounds each in weight and 28.1 cm. in height. The heifers in Group V, however, made only 15 percent of their increase in weight on pasture, while those in Group VI made 57 percent of their gain in weight on pasture.

### Age of Freshening

One of the objects of the experiment was to determine if the heavily fed heifers would mature earlier than the hand-fed heifers so as to make a return at an earlier age and so compensate to a certain degree for the extra feed cost. Table 11, which gives data on the dates of freshening of the various heifers in the self-fed and hand-fed groups, indicates that there is very little difference in the age of the first calving between the two groups. While the self-fed groups, as is especially noticeable in Group V, seemed to reach full size at an earlier

TABLE 11.—*Ages of Freshening of Self-fed and Hand-fed Heifers*

| Number of Heifer | Self-fed Groups — Age of Freshening | | | Number of Heifers | Hand-fed Groups — Age of Freshening | | |
|---|---|---|---|---|---|---|---|
| | Yrs. | Mos. | Days | | Yrs. | Mos. | Days |
| 71 | 2 | 5 | 18 | 70 | 2 | 6 | 7 |
| 81 | 3 | 0 | 17 | 72 | 2 | 6 | 13 |
| 83 | 2 | 10 | 29 | 77 | 2 | 3 | 23 |
| 86 | 2 | 5 | 2 | 84 | 2 | 10 | 0 |
| 44 | 3 | 4 | 2 | 85 | 2 | 6 | 6 |
| 41 | 3 | 5 | 6 | 32 | 2 | 11 | 17 |
| 39 | 2 | 3 | 23 | 40 | 2 | 3 | 21 |
| 111 | 3 | 0 | 25 | 42 | 2 | 3 | 14 |
| 113 | 2 | 4 | 11 | 46 | 2 | 11 | 14 |
| 114 | 2 | 3 | 16 | 109 | 2 | 6 | 16 |
| 116 | 2 | 3 | 1 | 115 | 3 | 0 | 0 |
| | | | | 141 | 2 | 8 | 24 |
| Average | 2 | 8 | 11 | Average | 2 | 7 | 16 |

TABLE 12.—*Production of Milk and Butterfat of Heifers in Each Group during First Lactation Period*

| Self-fed Groups* | | | Hand-fed Groups† | | |
|---|---|---|---|---|---|
| Number of Heifer | Pounds Milk | Pounds Fat | Number of Heifer | Pounds Milk | Pounds Fat |
| 44 | 9,439 | 401 | 32 | 5,838 | 260 |
| 41 | 9,877 | 322 | 40 | 13,072 | 369 |
| 71 | 12,054 | 367 | 46 | 11,954 | 363 |
| 81 | 10,859 | 401 | 70 | 11,093 | 342 |
| 83 | 12,614 | 424 | 72 | 11,995 | 356 |
| 86 | 6,474 | 329 | 77 | 8,148 | 234 |
| 109 | 8,095 | 275 | 84 | 10,979 | 389 |
| 115 | 8,090 | 460 | 85 | 4,683 | 222 |
| 141 | 9,131 | 357 | 116 | 12,981 | 487 |
| Average | 9,626 | 371 | Average | 10,016 | 336 |

*2 Jerseys, 1 Ayrshire, 1 Guernsey, and 5 Holsteins.
†2 Guernseys and 7 Holsteins.

age than the hand-fed groups, yet the animals did not seem to come into milk at any earlier age. This may have been due to failure on the part of some of the heifers in the self-fed groups to conceive on account of heavy fleshing. Four heifers in these groups ran over 3 years of age before freshening, while only one in the hand-fed groups reached the age of 3 years.

### Production

Table 12 gives the production of as many heifers as finished an entire lactation period in the herd. This table indicates that, when breed difference is taken into account, there is but little or no difference in the first calf production of the groups.

## SUMMARY AND CONCLUSIONS

Three trials were conducted to compare the efficiency of wintering dairy heifers by the use of a self-feeder, with wintering them in the usual manner by hand-feeding. The first two trials were begun when the heifers were approximately one year old and were run during one winter feeding season and the following pasture season. In the third trial the animals were put on the self-feeder as soon as they were old enough to eat grain, and except when on pasture they were kept on the self-feeder until time of freshening.

The heifers fed by means of the self-feeder made much greater gains during the period when they were fed by means of the self-feeder than did the heifers fed by hand. However, when all of the heifers were turned in a common pasture, the self-fed heifers made much slower gains than did the hand-fed heifers. Greater gains made by the hand-fed heifers during the period when the heifers were kept on a common pasture tended to offset the gains made by the self-fed heifers during the winter months.

The self-fed heifers, especially those self-fed from birth, reached their full size at an earlier age than did those fed by hand. The heifers fed by hand made up for their slow growth during the winter months by making greater growth during the summer months when they were on pasture and by continuing to grow for a longer period of time.

The self-fed heifers consumed less roughage but much more grain per pound of gain (approximately 4 times as much) as did those fed by hand. During the second year of Trial III, the self-fed

heifers obtained 80.3 percent of their digestible protein and 74.9 percent of their digestible nutrients from the grain ration, while the hand-fed heifers obtained only 31.8 percent of their digestible protein and 27 percent of their digestible nutrients from their grain ration.

The amount of digestible protein consumed for one pound of gain was very much greater (more than 100 percent on the average) for the self-fed heifers than for the hand-fed heifers. This was true when the amount of protein which they obtained from the pasture was not considered. It was not true, however, when the heifers were being fed less than their requirements of total nutrients, which occurred during the second winter in the case of Group VI.

The amount of total digestible nutrients consumed per pound of gain was higher on the average (about 50 percent) for the self-fed heifers if no account is taken of the amount obtained from the pasture. However, when the heifers were on winter feed there was very little difference in the amount of total digestible nutrients consumed per pound of gain. During the third trial, when the hand-fed group was being fed less than its requirements, it required considerably more for a pound gain than in the case of the self-fed group. This would indicate that a heifer to be most efficient should be fed somewhere near her requirements as denoted by the Morrison Feeding Standard.

The hand-fed groups made most of their gain when on pasture, while the self-fed groups made most of their gains during winter feeding. In the case of Group V, the self-fed group, only 15 percent of the gain was made on pasture, while Group VI, the hand-fed group, made 57 percent of their total gain on pasture.

Dairy heifers can make proper selection of grains as far as health and digestion is concerned, but not as to the proper or economical food value. The self-fed heifers did not come into milk at any earlier age, nor did they possess any better dairy qualities than did those fed by hand.

In conclusion it can be said that the self-feeding of grain is an expensive method of raising dairy heifers, as they make their growth at the expense of large quantities of expensive grains and small quantities of roughages and pasture, as compared to heifers fed by hand.

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